International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 08 Issue: 05 | May - 2024 SJIF Rating: 8.448 ISSN: 2582-3930

HAND AND FOOT OPERATED METAL ROLLING MACHINE

Mr. VRUSHABH RAHUL MENDHE[1], Mr. KAJAL KISHOR DAMKE[2], Mr. ASHWINI RAMCHANDRA VAIRAGADE[3], Mr. SAJAN VINOD WALKE[4],

Asst Prof. PRATIK P. CHAPHALE[5],

Asst. Prof. VAIBHAV H. BANKAR[6]

*[*1234]Student, VIT, ME Dept.,Nagpur*
*[*56]Prof. VIT,ME Dept,Nagpur*

Abstract -Metalworking and fabrication are industries where precision and adaptability are crucial. One of the most indispensable tools in these fields is the sheet rolling machine. This project focuses on designing and building a hand and foot operated sheet rolling machine, a versatile and cost-effective solution for bending and shaping sheet metal into cylindrical and curved forms.In the dynamic field of metalworking and fabrication, the ability to shape and bend metal sheets is crucial for a wide array of applications, ranging from industrial manufacturing to artisan crafts. A hand and foot operated sheet rolling machine is an essential tool designed to facilitate these processes in an efficient, precise, and cost-effective manner. Sheet Metal working industry a wide range of powe r and hand Foot operated machines are used. As the sheet metal industry is a large and growing industry different type of machines are used for different operation. Our project the sheet metal rolling is very simple in operation by using roller which is coupled with handle and pedal. This machine produces cylindrical objectives of diff erent diameters.This machine can be used in various fields. This machine consist of three roller which is coupled with a handle and connection the handle and foot operated pedal. This machine is simple in construction and working.

Keywords: Hand Crank, foot padel, rolling machine, rollers etc

1. INTRODUCTION

Sheet metal creation assumes a vital part in a metal assembling world. Metal sheet is utilized as a part of the generation of materials extending from devices, to pivots, cars and so forth. Sheet metal manufacturing ranges from profound drawing, stamping, framing and hydro shaping, to high vitality rate framing (HERF) to make desired shapes from different purposes. Application of sheet metal is there in tool making, automobiles industries, boiler shell industries and many more. Sheet metal forming, consisting of deep drawing, forging, and hydro forming, to create desired shape. More easy and elegant shapes may be folded from a single plain sheet of material without stretching or machining, if shape of sheet metal is the bending continuously the piece along a linear axis, this causes alteration of the original form of the sheet as it passes through a path way of bottom rollers. The present innovation relates to the plate bending machine which operates with rollers. Although there are many automated sheets rolling machines are presently available in market today, our aim was to design and develop such machine which is manually operated which can be used in small workshops with vey less cost.The main problem that people who are occupied with doing various metallic projects and generally constructions, faces the bending of metallic strips. The reason that this problem is arisen during these projects is because the metallic pieces need a lot of pressure, strength as well as accuracy to be bent. There are many machines to be used to achieve this but the cost is high. This construction is more user-friendly to everyone, relatively affordable, extremely useful and it will fill with feelings of joy and satisfaction the people who want to spend their time productively.

2. OBJECTIVES

The primary objectives of this research are:

1. Design Innovation: To develop a design for a hand and foot operated sheet rolling machine that maximizes efficiency and user control.
2. Accessibility: To create a machine that is affordable and easy to use, broadening its appeal to hobbyists, small businesses, and educational institutions.
3. Functionality and Versatility: To ensure the machine can handle a variety of metal thicknesses and types, providing reliable and precise results across different projects.
4. Safety and Ergonomics: To incorporate safety features and ergonomic design principles to enhance user safety and comfort during operation.
5. To design and fabricate a bending machine for metal strips.
6. To utilize unskilled worker with simple working principle.
7. To reduce the time and cost of the operation

3. METHODOLOGY

The research methodology for studying hand and foot operated sheet rolling machines involves a comprehensive approach encompassing several key phases. These phases include a literature review, design and modeling, material selection, prototype construction, testing and evaluation, and documentation.

1. Literature Review

Objective: To gather existing knowledge and identify gaps in the current understanding of hand and foot operated sheet rolling machines.

Steps:

Review Existing Designs: Examine academic papers, patents, and industry reports to understand the existing designs, mechanisms, and applications of sheet rolling machines.

Identify Key Features: Focus on the essential components, operational principles, and common issues associated with these machines.

Analyze Market Needs: Investigate the needs of potential users, including small workshops and hobbyists, to identify desired features and improvements.

2. Design and CAD Modeling

Objective: To develop a detailed and optimized design for a hand and foot operated sheet rolling machine.

Steps:

Concept Development: Sketch initial design concepts, considering user requirements and ergonomic factors.

Computer-Aided Design (CAD): Create detailed 3D models of the proposed machine using CAD software. This allows for precise visualization and modification of the design.

Simulations: Run simulations to predict the machine's performance, identify potential stress points, and optimize the design for durability and efficiency.

3. Material Selection

Objective: To choose appropriate materials that balance durability, cost, and ease of fabrication.

Steps:

Material Properties: Evaluate materials based on strength, weight, corrosion resistance, and cost.

Component-Specific Selection: Select materials tailored to specific components (e.g., high-strength steel for rollers, aluminum for the frame).

Supplier Research: Identify reliable suppliers for the selected materials to ensure quality and availability.

4. Prototype Construction

Objective: To build a functional prototype based on the finalized design.

Steps:

Component Fabrication: Manufacture the machine components using appropriate fabrication techniques such as machining, welding, and assembling.

Assembly: Assemble the components according to the design specifications, ensuring precision and alignment.

Initial Testing: Perform preliminary tests to ensure the basic functionality of the prototype.

5. Testing and Evaluation

Objective: To assess the performance, safety, and usability of the prototype.

Steps:

Performance Testing: Test the machine with various metal sheets of different thicknesses and materials to evaluate its rolling capabilities and accuracy.

Usability Testing: Observe users operating the machine to identify ergonomic issues and ease of use.

Safety Assessment: Conduct safety checks to ensure all moving parts are properly guarded and that the machine complies with relevant safety standards.

Data Collection: Collect data on performance metrics, user feedback, and safety observations.

6. Data Analysis and Iteration

Objective: To analyze test data and refine the design based on findings.

Steps:

Analyze Performance Data: Evaluate the machine's efficiency, accuracy, and durability based on collected data.

User Feedback: Incorporate feedback from usability testing to make ergonomic and operational improvements.

Design Modifications: Make necessary adjustments to the design, materials, or construction methods to enhance performance and safety.

Prototype Revision: Construct a revised prototype incorporating the improvements and conduct further testing as needed.

7. Documentation

Objective: To compile comprehensive documentation of the research process, design, and findings.

Steps:

Technical Documentation: Prepare detailed design drawings, material specifications, and assembly instructions.

User Manual: Create an easy-to-understand user manual including operating instructions, safety guidelines, and maintenance tips.

Research Report: Write a research report summarizing the methodology, findings, and conclusions of the study.

4. WORKING PRINCIPLE OF A HAND AND FOOT OPERATED SHEET ROLLING MACHINE

A hand and foot operated sheet rolling machine is a manually powered device used to bend and shape metal sheets into cylindrical or curved forms. The machine operates based on a simple mechanical principle involving the coordinated use of hand and foot mechanisms to drive the rollers that shape the metal sheet. Here's a detailed look at how it works:

Key Components

Rolling Cylinders: The machine typically has three rollers:

Upper Roller: This roller applies pressure on the metal sheet and can often be adjusted vertically to accommodate different thicknesses of metal.

Two Lower Rollers: These are fixed in position and work to pull the sheet metal through the machine as it is being shaped.

Hand Crank: A handle attached to one of the rollers, allowing the user to manually rotate the rollers and feed the sheet metal through the machine.

Foot Pedal: A pedal mechanism that can engage or disengage the rollers, enabling the operator to use both hands for guiding the metal while controlling the rolling process with their foot.

Adjustment Screws: These screws are used to adjust the spacing between the rollers, which is crucial for determining the radius of the bend.

Frame: A robust structure that holds all the components in place and provides stability during operation.

Working Principle

The operation of a hand and foot operated sheet rolling machine is based on the following steps:

Preparation:

Adjust the Rollers: Using the adjustment screws, set the spacing between the rollers according to the thickness of the metal sheet and the desired curvature.

Insert the Sheet: Place the edge of the metal sheet between the upper roller and the two lower rollers.

Engaging the Rollers:

Hand Crank Operation: Rotate the hand crank to start turning the rollers. This manual rotation pulls the metal sheet through the rollers.

Foot Pedal Assistance: Engage the foot pedal to maintain the rotation of the rollers without continuous manual cranking. This frees up the operator's hands to better guide and position the metal sheet.

Rolling Process:

As the sheet passes between the rollers, the upper roller applies pressure, bending the metal into the desired shape.

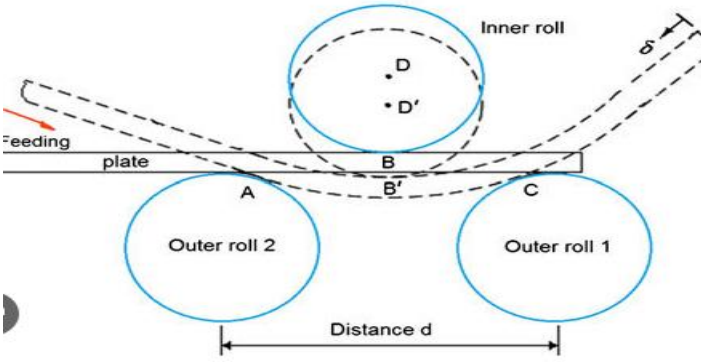
The continuous rotation of the rollers ensures a smooth and consistent curve or cylinder formation along the length of the metal sheet.

Adjust the position of the upper roller as needed to achieve the desired curvature. Tighter adjustments result in smaller radii, while looser adjustments produce larger curves.

Completion:

Continue feeding the sheet through the rollers until the entire length has been shaped.

If necessary, pass the sheet through the rollers multiple times, adjusting the roller positions incrementally to refine the shape and achieve the precise dimensions required.



5. ADVANTAGES

Cost-Effectiveness:

Hand and foot operated sheet rolling machines are generally more affordable compared to their motorized counterparts, making them accessible to small workshops, hobbyists, and educational institutions with budget constraints.

Portability:

These machines are typically lightweight and compact, allowing for easy transportation and installation in various workspaces. They are suitable for mobile operations or setups with limited space.

Versatility:

Hand and foot operated sheet rolling machines can handle a wide range of sheet metal thicknesses and materials, offering versatility in metalworking tasks. They are capable of rolling various metals such as steel, aluminum, and copper.

Precision Control:

Manual operation provides precise control over the rolling process, allowing operators to achieve accurate and consistent results. This is particularly beneficial for creating custom or intricate metal components.

Safety:

With fewer moving parts and no electrical components, hand and foot operated sheet rolling machines are generally safer to use compared to motorized alternatives. They pose less risk of electrical hazards and provide better visibility during operation.

6.DISADVANTAGES

Labor Intensive:

Manual operation requires physical effort from the operator, which can lead to fatigue, especially when processing large or heavy sheets of metal. This may limit productivity and increase the time required to complete tasks.

Limited Speed:

Hand and foot operated machines have slower processing speeds compared to motorized options. This may be a drawback in high-volume production environments where faster processing is essential to meet deadlines.

Lower Production Capacity:

Due to their manual operation and slower speed, hand and foot operated machines may have a lower production capacity compared to motorized machines. They may not be suitable for **mass production or large-scale manufacturing.**

Skill Requirement:

Effective operation of hand and foot operated sheet rolling machines requires skill and experience. Operators need to understand the machine's capabilities and limitations to achieve desired results consistently.

7.APPLICATIONS

Small Workshops and Garages:

Hand and foot operated sheet rolling machines are commonly used in small workshops, garages, and home-based businesses for metal fabrication, repair, and customization projects.

Artisanal and Hobbyist Metalworking:

These machines are popular among hobbyists, artists, and craftsmen for creating custom metal sculptures, artwork, and decorative pieces. They offer precision control for intricate designs.

Educational Institutions:

Hand and foot operated sheet rolling machines are used in technical schools, vocational training centers, and educational workshops to teach students metalworking skills and principles of machine operation.

Prototyping and Custom Manufacturing:

These machines are suitable for prototyping and small-scale custom manufacturing, where flexibility and precision are more important than high-volume production capabilities. They allow for experimentation and iteration in product development.

8. CONCLUSION

In conclusion, hand and foot operated sheet rolling machines are invaluable tools in the metalworking industry, empowering individuals and small businesses to create, innovate, and express their creativity in metal fabrication. By understanding their construction, operation, advantages, and limitations, users can leverage these machines effectively to achieve their metalworking goals. As we look to the future, continued innovation and refinement of these machines will further expand their capabilities and impact in the metalworking community.

REFERENCES

[1] V. B. Bhandari,“Design of Machine Elements” Mc Graw Hill, ISBN, 2012.

[2] Hiroyuki goto, Kenichiru, Hidenobusaitro, Yuuishikura and Yutaka tanaka, "Applications with a new 6- dof bending machine in tube forming processes".

[3] Jose Vitor Souze, International Journal of Machine Tools &Manufacture, 2002.

[4] Z. Hu, R.Kovacevic, M.Labudovic, “Experimental and numerical modelling of buckling instability of laser sheet forming”, International Journal of Machine Tools & Manufacture, 2002.

[5] Nayyar, P.E., Mohinder L. "A1". In Mohinder

L. Nayyar, P.E...Piping Handbook (7th Ed.). New York: McGraw-Hill. ISBN, 2000.

[6] Effect of internal pressure and shape imperfections on plastic loads of pipe bends under in-plane closing moment. Christo Michael, A.R.Veerappan, S. Shanmugan, Engineering Fracture Mechanics 105(2013)1 – 15.

[7] Cherniy.V.P. Effect of Curved Bar Properties on Bending of Curved Pipes. Journal of Applied Mechanics, Vol. 68, pp.650 – 655, 2001. [8] Cherniy. V. P. The Bending of Curved Pipes With Variable Wall Thickness. Journal of Applied Mechanics, Vol. 70, pp. 253 – 259, 2003.2013, 59-66